Natural Gas Market Design is Incompatible with Needs of Electricity Markets and Constrains Clean Energy Deployment

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America's natural gas and electric power industries are increasingly interdependent: electric generators have collectively become the nation's largest gas user, and gas-fired plants supply a large and growing share of the country's electricity.[1] Yet natural gas markets have not kept pace with the needs of their single biggest user. This disconnect is a challenge for both industries, and a potentially costly challenge for retail energy customers which could also stifle key innovations in the electric sector at a time when they are most critical.

The Disconnect Between Gas and Electricity Markets

Wholesale natural gas and electric market rules do not provide an effective means for power plants to transact to obtain the varying quantities of gas as power output and reliability needs fluctuate over the course of the day. The result is that energy customers pay far more than they should and reliability threats are exacerbated, largely because the gas markets do not create or foster price formation and price discovery (i.e., transparency) on an hourly or sub-hourly basis.

Even worse, the economic merits of clean energy deployment are diminished, because the market rules are not designed for power plants to obtain and price the fuel needed to balance renewable intermittency.[2] Thus the real cost of fast ramping (both up and down) by natural gas-fired power plants is not established or reflected in either the gas or electric markets, and there is no functional basis for competition among resources other than natural gas-fired power plants to provide the daily reliability services needed for a more renewable and responsive electric system. As the Environmental Defense Fund (EDF) and our colleagues at Skipping Stone observed and asserted before the Federal Energy Regulatory Commission (FERC or Commission),

> There cannot be a "smart" interactive grid unless the business rules governing the means by which gas is traded and dispatched are in sync with the evolving needs of the electric markets, and the needs of gas shippers and end users who are electric market participants.[3]

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1 U.S. Department of Energy, Natural Gas Implications of Increased Demand from the Electric Power Sector at v (Feb. 2015) (noting that the electric power sector is currently the largest consumer of natural gas in the United States).

2 Status Report and Supplemental Comments of the Desert Southwest Pipeline Stakeholders, Docket Nos. RM14-2, AD16-21, and ER16-1649 (Sept. 9, 2016) ("existing scheduling timelines for natural gas transportation coupled with the Commission's natural gas policies...are preventing firm contract holders in the Desert Southwest from obtaining timely access to natural gas that is needed to backstop the intermittent nature of these renewable resources and respond to unexpected operational contingencies.").

3 Comments of the Environmental Defense Fund, Conservation Law Foundation, the Sustainable FERC Project, and the Clean Energy Group, Docket No. RM14-2 at 3 (Nov. 28, 2014).

The natural gas market was not designed with the needs of gas-fired power plants in mind and natural gas transportation services do not reflect the variation in offerings, pricing and duration seen in the wholesale electric markets.[4] Although FERC continues to assess and gather data, the Commission has not yet advanced the market rule refinements necessary to commercially coordinate among and between the gas and electric markets. A synergistic gas market must allow gas power plants to vary receipts in concert with deliveries, to enable and support the variable sub-day demands for (and duration of) gas-fired generation, and it must provide transparent price information for those services.

EDF-led Analysis Illuminates Problems and Opportunities

Two recent sets of analysis illustrate the existence and cost of incompatibility between the gas and electric markets in New England, a region that exemplifies the growing national challenge as interdependency between the two markets increases. EDF focused on New England because its electricity system is increasingly reliant on natural gas-fired power plants,[5] while at the same time, the region is deploying progressively more renewable capacity in accordance with state climate policies and on the economic merits.[6]

The first analysis assessed pipeline scheduling and utilization on an hourly basis in New England for three years in order to better understand and correlate usage patterns with gas supply pricing.[7] In New England, policymakers and ISO-NE have repeatedly highlighted the purported need for more pipeline capacity into the region to reduce rates during peak gas usage and to maintain reliability.[8] In an efficient market, you would expect prices to be higher during periods of high demand, such as on cold winter days when local gas utilities have high

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4 Memorandum of Understanding Among PJM and the PJM Pipelines dated July 28, 2015 ("PJM has recognized the need for gas-fired generators to arrange for reliable and flexible natural gas pipeline services, but has expressed concern about the availability of such services and the willingness of pipelines to develop and price these services").

5 New England Power Grid 2015-2016 Profile, https://www.iso-ne.com/static-assets/documents/2016/02/NE_Power_Grid_2015-2016_Regional_Profile.pdf (in ISO-NE, natural gas resources supplied 15% of electricity in 2000, compared to 49% in 2015).

6 ISO New England, 2016 Regional Electricity Outlook at 9, https://www.iso-ne.com/static-assets/documents/2016/03/2016_reo.pdf (noting the drivers of change, including state public policies and economics).

7 Environmental Defense Fund, "Review of Pipeline Scheduling and Utilization Patterns in New England" (November 30, 2016).

8 Gordon van Welie, State of the Grid: 2017 at slide 7 (January 30, 2017), https://www.iso-ne.com/static-assets/documents/2017/01/20170130_stateofgrid2017_remarks_pr.pdf ("Inadequate fuel infrastructure, particularly natural gas infrastructure to serve New England's growing fleet of natural-gas fired power plants, is a current, and growing, reliability risk.").

customer heating demand. But you would also expect that pipelines delivering gas to areas of high demand, like Boston, to be nearly fully utilized.

EDF's study, conducted with an established academic expert on gas markets, found that utility behavior did not match rational market expectations. To the contrary, the study found that two large utilities in the region were effectively constraining pipeline capacity by scheduling far greater quantities for delivery than they were using, then down-scheduling at the end of the day -- far too late for the excess capacity to be used by others. As a result, significant amounts of otherwise usable pipeline capacity went unused on the coldest days of the year when prices were highest.

The key takeaway from this study is that commercial incentives in the gas market are misaligned in a way that diminishes efficient and full utilization of pipeline capacity, leading to behavior by pipeline capacity contract holders that is adverse to the economic interests of utility customers. In other words, flaws in the current natural gas market design can lead to exertion of market power, systemic inefficiencies, diminished electric reliability and ultimately increased costs.

The second New England study focused on daily interaction between and among the wholesale gas and electric markets.[9] It is premised on the fact that New England depends on gas-fired generation, and that hourly electricity clearing prices in the region are largely set based on the cost of natural gas fuel supply to those generators for a given hour. The study analyzed daily gas usage patterns by natural gas-fired power plants and the relationship between their gas usage, hourly electricity prices and revenues. The analysis demonstrates that the value of natural gas supply fluctuates over the course of the day, but the natural gas market primarily relies on a single daily "index" price that is established assuming that end users and power plants use a steady, non-varying (i.e., "ratable") quantity of gas each hour.[10] Put another way, the fundamental design assumption of "ratable" flow upon which transactions in the market are premised, is at odds with the reality of how natural gas-fired power plants, the largest gas customer, use natural gas and pipelines.

Notably, it is the pipelines' portfolio of assets and flexibility capabilities that enable generators to take varying quantities in a market that assumes all users take steady volumes,[11]

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[9] Environmental Defense Fund, "Variable Flows and Potential Pipeline Revenues Associated With Providing Variable Hourly Sub-Day Services to Electric Generation Market" (September 2, 2016).

[10] Ratable flow means that when a shipper schedules deliveries with a pipeline, it must schedule hourly delivery of 1/24th of its contracted daily quantity every hour.

[11] Comments of the Interstate Natural Gas Association of America, Docket No. AD12-12 at 21, n.20 (March 30, 2012) (providing examples of flexible pipeline tariff services).

but where the largest customers, power generators, do not.[12] The problem is the lack of a standardized market construct for pricing flexible flows which consequently precludes price formation and price discovery, and any meaningful valuation for that flexibility.

Because the market does not create published or discoverable hourly prices, [13] and assumes ratable flow, power generators are compelled to develop creative methods such as having their gas traders divvy up non-ratable capacity into hourly chunks that correlate to generators fluctuating needs over the day. Although such transactions are occurring by the hundreds every day,[14] the price for obtaining hourly gas supply is opaque at best, and there is not an organized structure to formulate prices as necessary for market participants to understand and transact based on a common understanding of the value of hourly flows.

When demand is high, the hidden sub-day market becomes stressed and illiquid such that there are not enough sellers and/or buyers in the market.[15] On the coldest days when heating customers are in need of supply, prices tend to skyrocket but without collective market participant knowledge of whether there is available pipeline capacity and its value. [16]

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[12] Quadrennial Energy Review, U.S. Department of Energy (April 2015), Appendix B: Natural Gas, p. 10 ("many gas-fired power plants use large amounts of natural gas over short periods of time throughout the day. A generator that is needed to meet daily peak demand may not be dispatched until early afternoon, consuming no gas at one moment then drawing very large volumes the next").

[13] Comments of Exelon Corporation, Docket No. RM16-5 at 13 (April 4, 2016) ("the available indices to guide estimation of costs are very limited. Natural gas price indices are not published until the evening prior to the operating day, hours after the gas market closes and day-ahead market offers are due.").

[14] Northeast Gas Association, Challenges Facing the Natural Gas & Electric Power Interface in New England – And Opportunities to Improve Mutual Reliability at 5 (April 2012), http://www.northeastgas.org/pdf/nga_background_paper.pdf ("Natural gas pipelines are generally designed to provide hourly flows conforming to usage of traditional gas customers located within LDC territories, using gas in an operationally reasonable, consistent and predictable pattern throughout a typical day. In contrast, many gas-fired generators are often required to use 24 hours' worth of gas over a shorter span of hours (i.e., four, six, eight, twelve hours). This consumption profile is not consistent with typical and historical pipeline operational design, and – depending on the level of usage and system/weather conditions – cannot be sustained.").

[15] Joint Comments of PJM Interconnection, L.L.C and Southwest Power Pool, Inc., Docket No. RM16-5 (April 4, 2016) (explaining that "the days when natural gas markets are "tight"...are precisely the days when the price of natural gas is less transparent to market sellers (and RTOs/ISOs) because the actual price paid by a market seller for gas on the bilateral market is farthest away from index prices or what a market seller typically pays for natural gas under normal conditions.").

[16] *See, e.g.*, Motion to Intervene and Comments of the American Petroleum Institute, Docket No. ER16-372 at 4 (September 16, 2016) ("During times of system stress, multiple parties are likely to be vying for natural gas supplies, which may cause commodity prices to fluctuate

The unresolved conflict between the design assumptions underpinning the market (ratable flows priced and balanced daily) versus how power plants actually use and pay for fuel supply (continuous variability whereby the value of fuel supply constantly changes, but without meaningful price discovery) amounts to a recipe for chaos. Reliability is threatened on the coldest days because the market does not efficiently reconcile supply and demand.

In order to maintain reliability on days with high demand, power system operators are forced to intercede to balance power plant fuel needs with pipeline supply primarily by exchanging data (such as pipeline pressures and expected power generation hourly takes) as between pipelines and power plants.[17] Rather than having a market that efficiently transacts to match hourly pipeline capacity with generators' fuel supply needs by establishing prices and value, a party that functionally lacks a commercial relationship with either is forced to mediate as between the pipelines and their largest customers in order to keep the lights on.

Design Problems Bias Market Against Clean Energy Deployment and Sound Climate Policy

The implications of market design obsolescence are more far-reaching than just reliability. Because the market design expressly values and prices ratable inflexible pipeline capacity rather than just-in-time fuel delivery in the fluctuating volumes used by power plants, the market does not provide an economic signal that efficiently channels investment for new infrastructure to provide varying non-ratable flows. Put another way, without a market that prices and values sub-day variable fuel supply as used by electric generators, there is not an economic signal indicating where and how much new delivery capacity is needed, and more importantly, the parameters for economically rational investment in new pipelines and/or alternatives to pipelines.

It is well-understood in New England that power plants are unwilling to commit to long term contracts for pipeline capacity.[18] What is less understood is why. To put it simply, pipelines simply are not commercially offering a service that provides value to generators in excess of cost. As discussed above, the transactional construct is so dysfunctional that a third party without a commercial stake, is often forced to intercede and mediate between supply and

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dramatically and quickly based on supply availability, transportation constraints, and location of heating load and electric generation customers.").

[17] *See* section 3.0(b) of Attachment D ("Information Policy") to ISO New England's tariff, as accepted in *ISO New England, Inc.*, 146 FERC ¶ 61,159 (2014).

[18] Algonquin Gas Transmission, LLC, Docket No. RP16-618-000 at 3 (Feb. 19, 2016) ("Given that generation units are subject to economic dispatch, i.e., units with lower marginal cost are dispatched first, natural gas-fired generators may not be dispatched if there is sufficient generation with lower marginal cost to meet load requirements at any time. Accordingly, natural gas-fired generators in competitive markets may not have the economic incentives to pay for year-round firm interstate pipeline capacity when they will not be dispatched for periods during any year.").

demand. As long as the core transacted commodity is inflexible capacity, the market cannot channel investment in infrastructure that actually provides value to the system, i.e., investment in infrastructure that modulates system sub-day and peak-day variability. Instead, worried policymakers and system operators call for out-of-market schemes to pay for and build more pipeline capacity as an analog for deliverability.[19]

Long term contracts for pipeline capacity which is unneeded from a market rationale standpoint is a prescription for uneconomic fossil fuel lock-in and stranded costs being imposed on energy consumers paying for excess capacity. Moreover, because the wholesale natural gas and electric markets generally do not price the flexible reliability services that natural gas provides, the markets do not spur competition and/or innovation in methods to provide the most valuable attribute of a cleaner, more dynamic grid: flexibility.[20] In effect, unpriced flexibility from the natural gas supply chain, paid for and ensconced within the rubric of long term pipeline capacity, effectively prices-out of the market more dynamic, data-driven flexibility resources like batteries and demand response because the market construct is not designed to reflect and call forth competition to garner the system value that they can provide.

Market Refinements Can Overcome Market Inefficiencies and Reliability Challenges

A solution to these problems lies in market rules which codify and standardize pipeline services that are useful and economically valuable to power generators. Pipelines strive to meet the needs of their customers and provide gas on a more flexible basis.[21] But the lack of formal market rules or industry standards governing these services constrains the ability to transact, rendering transactions uneven and opaque. EDF sought to address this by participating in the Gas Electric Harmonization forum at the North American Energy

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19 Request for Approval of Firm Transportation Contracts with Algonquin Gas Transmission, LLC, D.P.U. 15-181 (Dec. 18, 2015) (NSTAR Electric Company and Western Massachusetts Electric Company each d/b/a Eversource Energy proposing a new Electric Reliability Service Program directed by an Electric Distribution Company Gas Asset Executive Committee and administered by a capacity manager that would acquire all of the electric distribution company capacity on the Access Northeast Project and release the capacity pursuant to established parameters).

20 California ISO, Commitment Costs and Default Energy Bid Enhancements Straw Proposal (June 30, 2017)(" The California ISO believes suppliers need more flexibility to reflect unique costs, price volatility, and other business considerations than its current market rules provide. By enhancing its bidding flexibility, the CAISO can better support integration of renewable resources through incentivizing flexible resources participation during tight fuel supply, account for costs of flexible resources (gas and non-gas) to reduce risk of insufficient cost recovery, and further encourage participation in its markets.")

21 Algonquin Gas Transmission, LLC, Docket No. RP16-618-000 at 5 (Feb. 19, 2016) (noting that Algonquin provides hourly scheduling that far exceeds the standard NAESB cycles as well as non-ratable hourly flows on an interruptible basis).

Standards Board (NAESB), a non-profit organization that develops standards for the gas and electric industries.

EDF, along with others, proposed a definition for a "Shaped Nomination," which allows a customer to provide to a pipeline the specific quantities of gas it will use in each hour over the course of a day, and suggested a standard for how a customer should communicate this information to the pipeline.[22] Standardizing the market approach for shaped flows (i.e., sub-day flow variability) is a cornerstone to foster trading and hourly transactions for varying volumes of gas delivery over the course of the day. In other words, shaped flows would provide granularity and visibility, and help evolve the natural gas market commercial rationale from one which primarily values and prices pipeline capacity, to one which is also structured to convey and transact for the time-varying value of gas receipts and deliveries. EDF's proposal was broadly supported by energy market participants and voting members of NAESB but was not carried to fruition due to the opposition of one out of five industry segments.[23]

As there is broad industry support, including by all voting market participants on the NAESB Gas Quadrant Executive Committee (with the exception of local gas distribution utilities), the Commission should advance and integrate into the market rules standards for shaped flow transactions. A recently-initiated FERC policy docket seeks to "increase transparency and support greater robustness in natural gas price formation."[24] The proposed standards for shaped flow transactions are precisely the type of commercial and regulatory solution needed to foster more granular price formation and enhance the efficiency of the markets.

In order for the Commission to succeed, it must align the market design construct with contemporaneous and evolving market conditions which are characterized by increasing use

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[22] North American Energy Standards Board Status Report for Submittal to the Commission Concerning FERC Order No. 809 Coordination of the Scheduling Processes of Interstate Natural Gas Pipelines and Public Utilities, Docket No. RM14-2 at 5, n.10 (March 30, 2017) ("NAESB WGQ Proposed Definition 1.2.[z1]: A Shaped Nomination is a nomination in which a Service Requester provides both a daily quantity and a quantity for each hour of the Gas Day, with each hour beginning at the start of the hour (e.g. 10:00 AM)"); *see also id.* at 5, n.11 ("NAESB WGQ Proposed Standard 1.3.[z1]: Where a Transportation Service Provider offers a service under its tariff, general terms and conditions, and/or contract provisions which expressly provides for a Service Requester (SR) to submit a Shaped Nomination, the SR should submit its nomination for that service as a Shaped Nomination using NAESB WGQ Standard No. 1.4.1 (Nomination). Receipt of service expressly providing for the use of a Shaped Nomination may require additional coordination with interconnected parties.").

[23] *Id.* at 5 (noting that "[s]everal representatives of the pipeline segment cited the benefits of standardizing communications for those that offer Shaped Nomination services" but that the motion ultimately did not receive the requisite votes from the LDC segment.").

[24] Developments in Natural Gas Index Liquidity and Transparency, Supplemental Notice of Technical Conference, Docket No. AD17-12 at 1 (June 13, 2017).

of natural gas by electric generators, in an energy system that is becoming more responsive, dynamic and renewable. The Commission has another opportunity to synchronize the business rules governing the natural gas markets with the evolving needs of the electric markets, and the needs of pipeline customers and end users who are electric market participants. Progress towards a clean, reliable, customer responsive and affordable energy system depends on it.